Max-Planck-Institut für Eisenforschung, Düsseldorf
Department for Microstructure Physics and Alloy Design

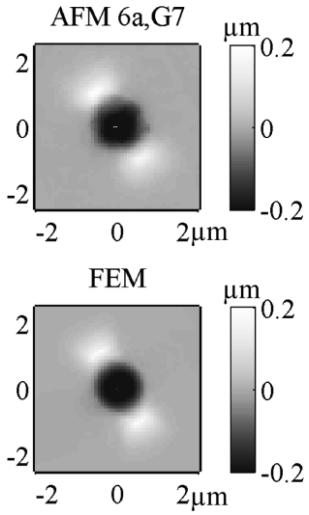
Characterizing and modeling the mechanics of crystalline interfaces

(Post-Doc or PhD Position)

Background

The strengthening effect of grain boundaries is one of the key components in the development of modern structural materials. Despite intense research, the precise nature of the often beneficial effects of grain boundaries have not been understood to a level which would allow for theory guided optimization of microstructures and accelerated alloy development. The current project aims to combine, improve, and apply recently developed approaches to investigate and quantify the micromechanical behavior of grain boundaries. Linking the topographic information around indents with state of the art simulation methods, a sound understanding of the interplay between grain boundaries and heterogeneous plasticity in titanium polycrystals is sought.

The goals of this research are: (1) Carry out indentation within the interiors of large grains of alpha-titanium to effectively collect single crystal data coupled with extensive (three-dimensional) characterization of the resulting plastic defect fields surrounding the indents. By correlating with models of the indentation, a precise constitutive description of the anisotropic plasticity of single-crystalline titanium shall be developed. (2) Extension of this methodology to indentations close to grain boundaries, i.e. quasi bi-crystal deformation. (3) Comparison of the measured characteristics of indentations at grain boundaries to simulated indentations as predicted by a constitutive model calibrated using the single crystal indentations. (4) Based on this qualitative understanding, a grain boundary transmissivity description will be developed, implemented into a non-local crystal plasticity formulation, and validated against the collected indent characteristics.



Requirements

A solid background in physical metallurgy, polycrystal mechanics, dislocation plasticity, continuum mechanics and proficiency in English are required. Prior experience in microstructural characterization such as EBSD or AFM is beneficial. Programming skills (Fortran, Python, Matlab) and experience in numerical simulation and finite element modeling are strongly appreciated.

Job Opening

Funding for this position is immediately available through the DFG-NSF Materials World Network for a period of three years (2012-2015). The work will be carried out in close cooperation with our partners at Michigan State University. We are an equal opportunity employer. Applications will be reviewed in the order that they are received until the position is filled.

Please send your application as a single pdf file or by mail to

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References

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Y. Yang, L. Wang, C. Zambaldi, P. Eisenlohr, R. Barabash, W. Liu, M.R. Stoudt, M.A. Crimp, T.R. Bieler (2011) JOM, 63(9), 66-73, doi: 10.1007/s11837-011-0161-8